Sounding Rocket Working Group
June 29, 2006

NASA Sounding Rocket Operations Contract (NSROC)

Goddard Space Flight Center

SRWG Agenda - NSROC

NSROC State of Affairs	Rob Maddox
Recovery AIB	Dave Krause
MRLS/Mesquito Development	Dave Krause
Celestial ACS AIB	Ricky Stanfield
Guidance, Navigation & Control	Walter Costello
Electrical Engineering	Shelby Elborn
Mechanical Engineering	Giovanni Rosanova
Conclusions	Rob Maddox

Program Manager

Rob Maddox

NSROC Programmatic

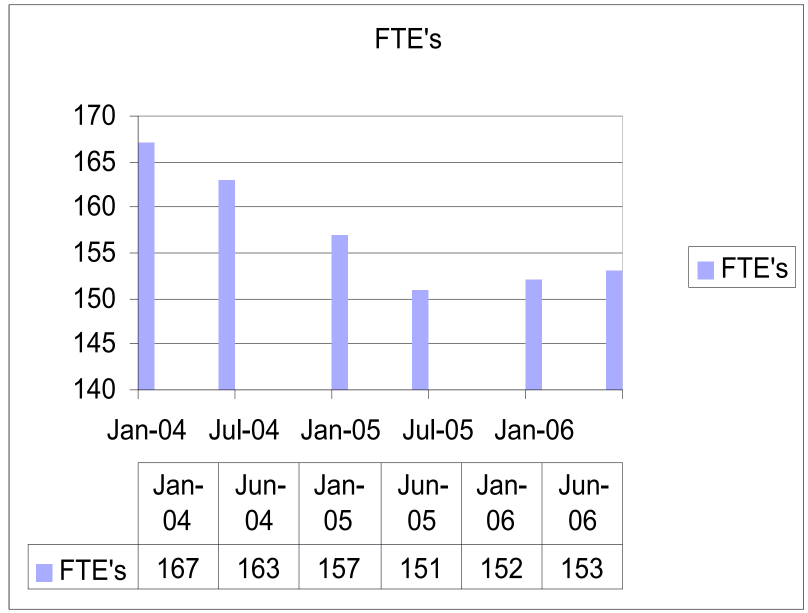
- Contract Status
  - Approaching mid point of contract year 8
  - Maintaining Very Good PEB scores
  - NG rolled out a new sector on Jan 1, 2006
    - Northrop Grumman Technical Services (NGTS)
    - NSROC contract moved to NGTS from NGIT
    - Jim Cameron appointed sector president
    - No significant change to NSROC
- Subcontract Status
  - Sub contract mods were issued to all teammates to extend second option
  - Aerojet – Maintained minimal support for Cruddace mission
  - Bristol – Black Brant motor procurement
    - Production of 12 Black Brant motors continues
  - DTI – Oriole motor procurement on hold, funding limitations, no reimbursable projects require Oriole.
  - Saab – Significant effort underway for S-19L conversions and GSE
  - Herley Industries – Chairman indicted for fraud. Herley placed on government debarred list. Sole provider of WSMR approved radar transponders. NSROC/NASA requesting approval to place order for radar transponders.

Programmatic

- Challenges
  - Implement new technology
    - New Attitude Control Systems
    - New Boost Guidance systems
    - New vehicle configurations
    - New Electrical Systems
  - Complex Missions (Methods outside experience envelope)
    - Earle, Craven, Lessard, Chakrabarti, Boch, Technology Demo Flights
  - Budget
    - Balancing staff, procurements, reimbursable workload, to a dynamic budget
  - Schedule

Programmatic

- Staffing
  - 153 FTEs
    - Up 1 FTEs since last SRWG
    - NASA funded = 142 FTEs
  - Reimbursable Offsets for FY 06
    - Planned = 15 FTEs
    - Realized to date = 14.6 FTEs
  - Plan to add additional engineering staff for reimbursable work



Programmatic

- New Business Opportunities
  - Navy ARAV exercises (Nov 2006)
  - Air Force/MIT-LL Airborne Laser “MARTI” (October 2006)
  - Air Force Airborne Laser “Terrier Lynx Vehicle” (Sept 2006)
  - MDA Tracking Targets
    - Infrasound 5&6 (WSMR)
    - Thaad (WSMR August 2006)
    - Battelle BBXI Tracking Target (WFF 2007)
    - Systima Deployment flight test (WFF 2007)

NSROC Outreach

NSROC Co-op and Intern Program

- Spring 2006 – 6 Interns/Co-ops
- Summer 2006 – 10 Interns/Co-ops
- Established intern program with Eastern Shore Comm. College
  - 2 part time positions opened and filled with students
- NSROC has hired 7 Intern/Coop graduates as full time engineers

Recovery AIB

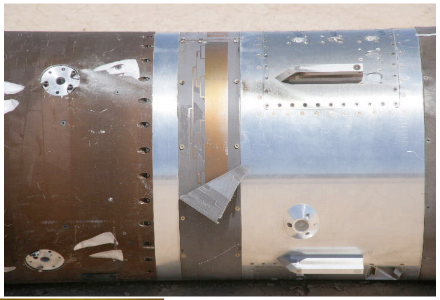
Dave Krause

36.203/Rabin Recovery System AIB

- Launch Date: April 12, 2006
- Location: White Sands Missile Range, NM
- PI: Dr. Doug Rabin, Goddard Space Flight Center

Mission Anomaly: Heat Shield deployed at ~25k ft, prematurely. Payload was instate of high dynamics, coning about the cg ±30° while spinning up to 3 Hz.

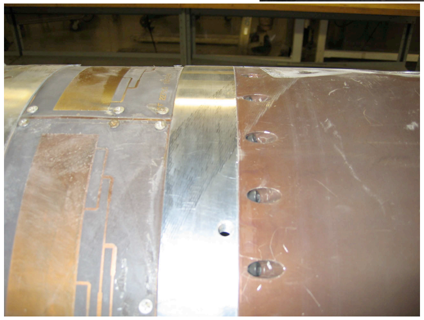
Root Cause: Not conclusive yet. Potentially exceeding the heat shield pyro's autoignition temperature. Data suggests chute risers wrapped around payload.



Corrective Action:

tbd

May include lower the "Probability of Exceeding the Flight Envelope". (PEFE includes Q_{actual}, $Q_{predict}$, % static margin, previous heating damage from ~120 flights)



Could impact certain telescope payloads and their long empty optics section.

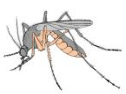
Mesquito Development

Mesospheric Sounding Rocket

Dave Krause

Mesquito Development
Developmental Desirements

- Mesquito Task started in May 2006
- Greg Smith is proving task oversight from the SR Program Office
- Task requirements:
  - Develop a low-cost sounding rocket to provide a platform for temporal and spatial measurements in the lower mesosphere.
  - Use the military surplus motor, MLRS (Multiple Launch Rocket System), to provide the propulsion.
  - Extend the flight proven Metrockets, Astrobee D, Small Rockets knowledge as a basis for design fineness, robustness and functionality.



- Science Considerations, Desires
  - Collection of Dr. Pfaff combined considerations and tiered experiments
    - Apogee: 100 km desired
    - Launch flexibility of 6 in 3 hour period
    - Low cost
    - Adaptable to various experiments
  - Additional discussion with Drs. Swenson and Lynch
    - Mechanical interface
    - TM interface
    - Power needs

Mesquito Development

Developmental Plan

Design Challenges

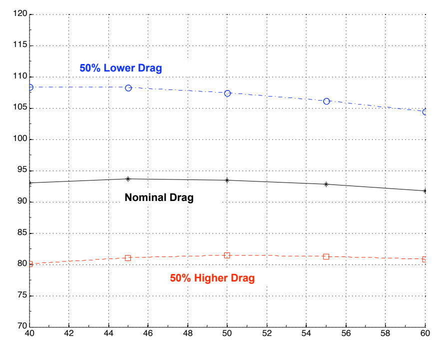
- Experiment Interface
  - Meets the mechanical, electrical and TM desirements
  - Separate nosecone
- Altitude
  - 100 km desire, in process
- Motor Usage
  - Awaiting system specification document from DoD
  - Also awaiting inert motor, igniter
- Acceleration
  - 100+ gs during the motor burn
- Thermal
  - Keep the hot body thermal from the electronics
- Design for
  - Low cost
  - Ease of fabrication
  - Ease of operations
  - Temporal usage (6 in 3 hrs)
- Launcher Interface/Dynamics

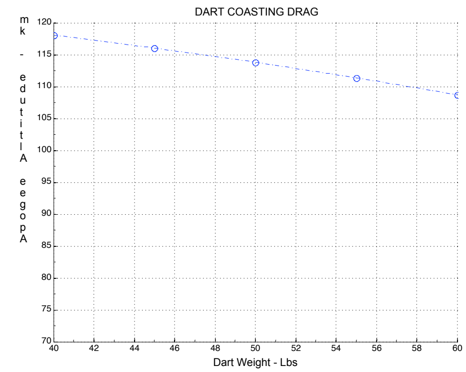
- Developmental plan uses 6 flight tests to prove the vehicle.
  - 3 flight tests to prove the vehicle
    - Aerodynamics & External geometry
    - Dart separation
    - Structural Stoutness
    - Launcher interface
  - 3 flight tests to prove the electronics
    - TM
    - Power
    - Payload diagnostics
    - Nosecone separation
    - Experiment interface

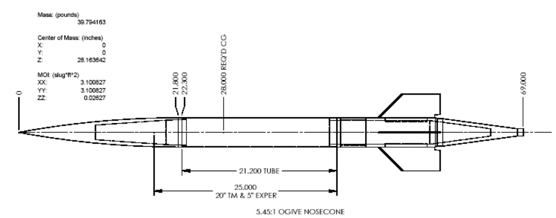
Mesquito Development

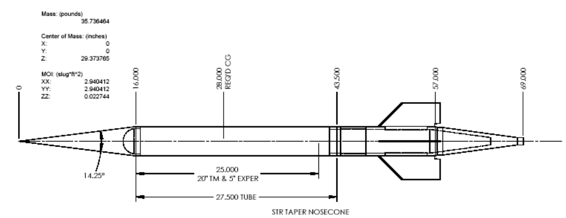
Current Status/Optimization Study

- Performance Analysis
  - Aero surfaces definition
    - dart fins, nosecone, boat-tail
    - Booster fins, interstage
  - Optimize for max altitude
  - Find the knee in the curve
- Mechanical/Structural
  - Booster design
    - Fins, Interstage, Lugs
  - Dart design
    - Structure with nosecone, body tube, tail assembly w/ fins
    - Band Antenna; S-band, GPS
    - Separable Instrumentation insert (potted)
    - EXP Bay under split nosecone
    - No outgassing nosecone pyro
  - Launcher interface
    - Design Goal is to have supplemental rail that will interface to all existing launchers



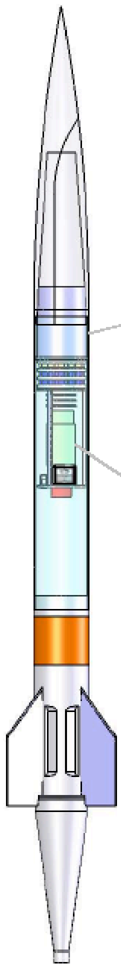


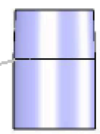


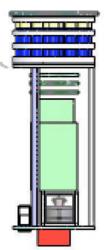


Mesquito Development

EXP Interface – Level 2 Payload







DRAFT – PRELIMINARY - ETC.

EXP Bay Gravimetrics

Length: ~5.2+”

Diameter: 3.5 “

Total Volume:~50 in^3

Mass:~5 lbm

cg: tbd

Note: requirement will be to match a gravimetrics to maximize performance.

Instrumentation Insert

Length: 10.1”

Diameter: 3.5 “

Total Volume:~97 in^3

Mass:~6 lbm

Note: final packaging will include a low weight, syntactic foam that will encapsulate the instrumentation

MLRS-Mesquito
Experiment Power, Data & Interface Guidelines

Provided Power

12 Cell NiMH Batteries providing 12 to 15.6 Volts unregulated power @ 0.85 A-hr which can provide up to 2.4 Amps for a total “Internal Power” on-time of 600 seconds.

Science Data

Primary Science data will multiplexed via synchronous serial digital interface (RS422 differential 5 Volts) identical to the WFF93 serial digital interface. Max number of serial digital inputs = 2

Maximum composite PCM data bit rate = 2 M bits per second

Data resolution = 16 bits per word

Science Housekeeping analog channels = 8 to 16 at 14 bits per word resolution

Science Housekeeping asynchronous data = 2 channels with maximum baud rate of 115.2K

Possible Science Data Option = parallel digital data for primary science data

Data and Power Interface

Experiment power and data will be accommodated via one 37 pin micro-D pre-wired interface

In-Flight Timed Events

A 30 channel electronic timer will be incorporated for nose cone ejection actuation which will allow considerable capability for Experiment in-flight event control if needed.

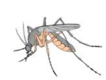
PCM Design Concept

To keep mission costs to a minimum capability to change PCM data formats, data rates and word resolutions is going to have to be minimized. NSROC’s desire is to have several fixed formats that can be utilized by the Experimenters with minimum format mods or changes.

Mesquito Development

Schedule & Events

Task Start	MAY 2006
Concept/Optimization	Mid-JUL 2006
Concept/Performance Review	JUL 2006
Detail Design	JUL 2006
Structural Review	AUG 2006
Vehicle Dev Flights	
3 ea	AUG-OCT 2006
Instrumentation Review	OCT 2006
Instrumented Flight Tests	
3 ea	NOV 2006 - JAN 2007
EXP Interface Document	FEB 2007
Ready for Prime time	Spring 2007



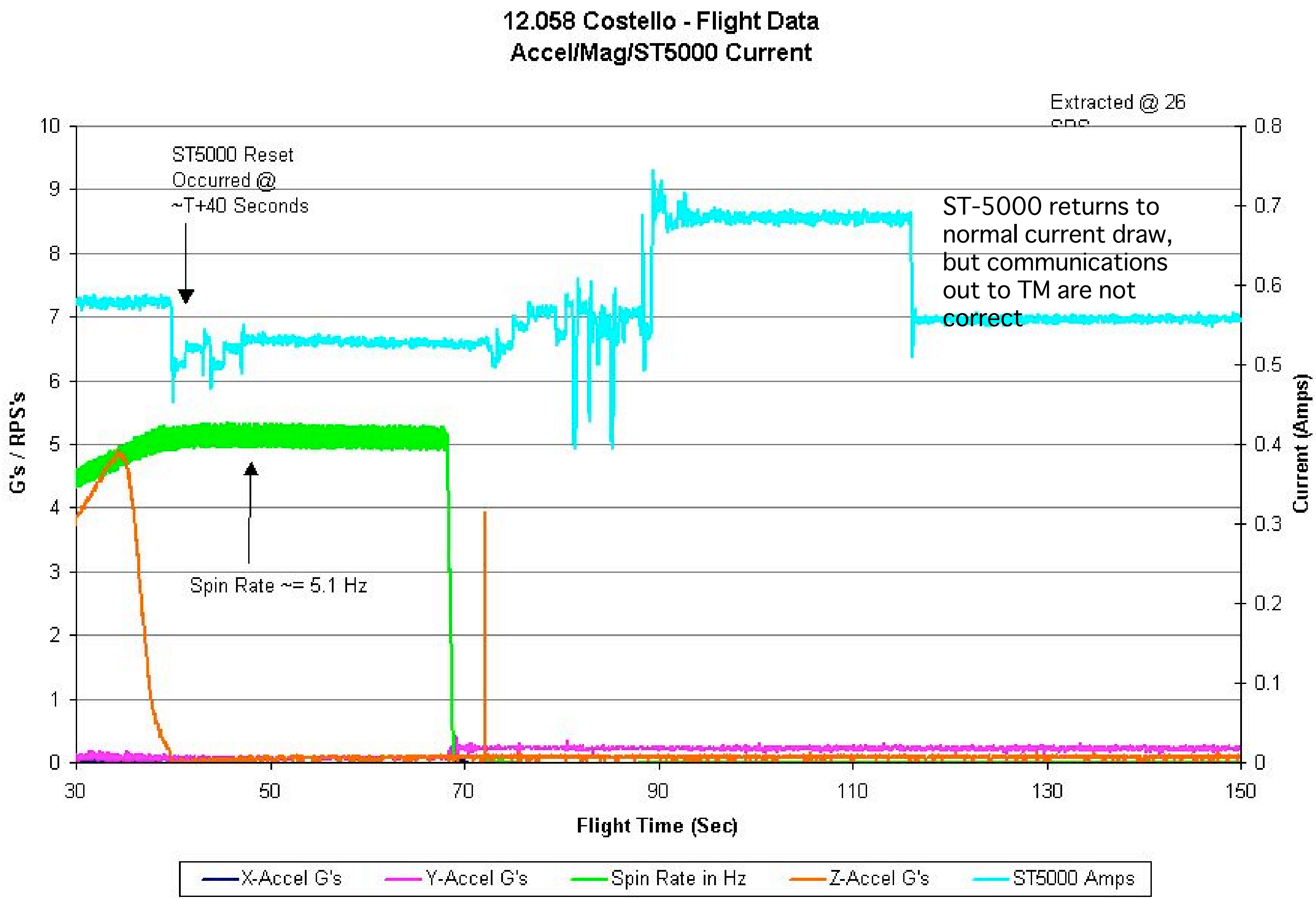
Celestial ACS AIB

Ricky Stanfield

12.058/Costello CACS Anomaly

- Celestial ACS suffered an anomaly during flight
  - ST-5000 CPU reboots at about T+40 seconds and again at T+44 seconds
    - First event coincides with max roll rate and stage 2 tail off
    - Second event coincides with no physical event (return to equilibrium)
    - Vibration environment is very low at the anomaly time
  - ST-5000 nominal reboots take about 50 seconds
  - ST-5000 communications after reboot is correct in content, but greatly elongated in time
    - Each character took 150mS (4mS is normal)
  - CACS never saw a valid message and continued to request the ST-5000 to “send data” at 4 second intervals
  - CACS performed other maneuvers successfully, but without ST-5000 interactions

12.058/Costello CACS Anomaly



12.058/Costello AIB Objectives

- AIB is seeking to identify causes of the reboot itself
  - Reboot triggers include electrical discontinuities or shorts that deregulate the ST-5000 DC/DC converter which in turn upset power to the sensitive ST-5000 CPU Chip
  - These triggers may have occurred inside the ST-5000 Box or in the external harness
  - Reboot triggers might also include erroneous software commands due to watchdog timer hiccups or command reset functions, though these seem unlikely
- AIB is seeking to identify causes of communication irregularities after the reboot
  - Power-on order between ST-5000 and CACS, and reset commands at random times have produced odd current patterns and unexpected system states in our tests
  - Level to which the CACS and ST-5000 cooperate to recover the combined system after an error

12.058/Costello AIB Progress

- AIB has been able to trigger reboots though shorts of power lines to the ST-5000 camera head in an area thought to have been pinched in/after flight
  - But the current signature does not yet match that from flight
  - No signs of trauma to the camera head or harness anywhere else
  - Ground testing has never reproduced the slow communications
- All other tests have also failed to reproduce the problem
  - Functional spin tests to 6Hz (normal and inverted)
  - Cable harness continuity “wiggle” tests
  - Sequence tests with manually triggered “soft” reboot events
  - Vibration testing was avoided to preserve damage from mission
  - Detailed inspection showed no obvious signs of failure and/or debris in the ST-5000 Box or the camera head

12.058/Costello AIB Plans

- AIB is still looking for shorts or discontinuities outside and inside the ST-5000 Box
  - More invasive testing of the ST-5000 boards is planned
  - Continued wire harness testing is planned
  - AIB has an evolving fault tree to map and eliminate failure sources
- AIB is investigating the reboot sequence and perceived software weaknesses
  - ST-5000 ability to reboot in the presence of CACS “send data” commands
  - CACS ability to reject invalid ST-5000 communications
  - Improved system level testing to characterized the interaction of the CACS and ST-5000 to unplanned, unintended “off-nominal” start-up sequences

12.058/Costello AIB Prognosis

- AIB plans to make recommendations that will preclude a reboot and/or make the system more robust to them
- ST-5000 Box was a source of concern during T&E
  - Broken standoffs and fatigue damaged leads raised concerns
  - AIB may not be able to exonerate the Box from this anomaly
  - Separate protected power supply for the CPU is likely recommendation and should be straight forward to implement
- Software improvements may also be quick to implement, but
  - Systematic process to characterize CACS/ST-5000 robustness to off-nominal power-up conditions could take several weeks
  - If warranted, the redesign/re-qualification of the ST-5000 Box or boards could take months
  - If the continuity problems are pushed back into the Box, then it is less trustworthy for future flights in the near term

12.058/Costello AIB Implication

- The results of the AIB process will have an impact on the following missions
  - 12.059 Costello “Scott, B” 09/--/06
  - 36.207 Cruddace “Gass, T.” 11/21/06
  - 36.220 McCandliss “Gass, T.” 11/21/06
  - 36.224 Cash “Gibb, T.” 11/28/06
  - 36.225 Chakrabarti “Gass, T.” 1/23/07
  - 36.226 Bock “Gibb, T.” 5/16/07
  - 36.235 Harris “Scott, J.” 6/1/08
- The NSROC GNC Group is working to minimize schedule impact to these missions, while the AIB finishes its evaluation and corrective measures are taken

GNC

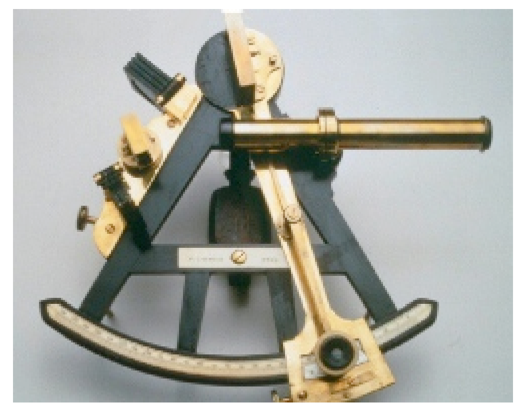
Walt Costello

GNC – Walt Costello

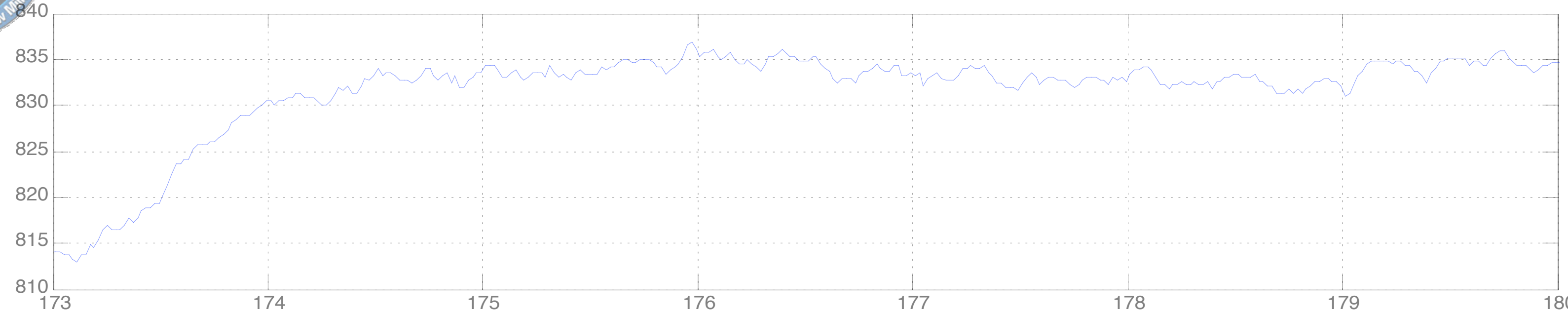
- Celestial ACS
  - Test Flight: ST-5000 Anomaly
  - Celestial Mission Schedule
  - Challenges
- Boost Guidance Systems S-19A, S-19D, and S-19L
- GPS Velocity Vector Input to NIACS
  - Seybold 41.068 WSMR April 5, 2006 (successful test flight)
  - Earle 36.218 Wallops Sept 2006
  - Robertson 41.069/070 Andoya June 2007
- GLN-MAC Attitude Determination Performance
- Digital Magnetometer Performance
- Poker Flat Campaign, 2007

12.058 ST-5000 Anomaly

- ST-5000 Rebooted at t+40 and t+44 seconds
  - Possibly caused by pinched wire could draw down 5V power (only had to sag 0.25 V to cause reboot)
    - Does not match the current signature that occurred in flight
    - Still under investigation
  - Marginal Design: – 5 V power came in from another box instead of being conditioned within box from 28 V primary power
- After Reboots, ST-5000 came up in anomalous state and failed to communicate with ACS
  - Some software defects have been found in ST-5000
  - Still under investigation, complete explanation still not found
- Otherwise Celestial ACS performance was nominal
  - GLN-MAC performance good, stars seen on ST-5000
  - video downlink
  - Uplink worked very well.

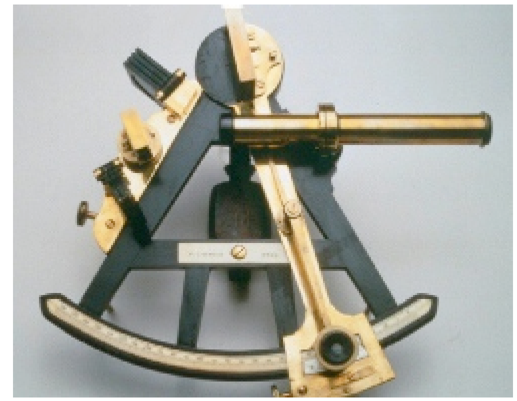


12.058 CACS Uplink



Scheduled Celestial Missions

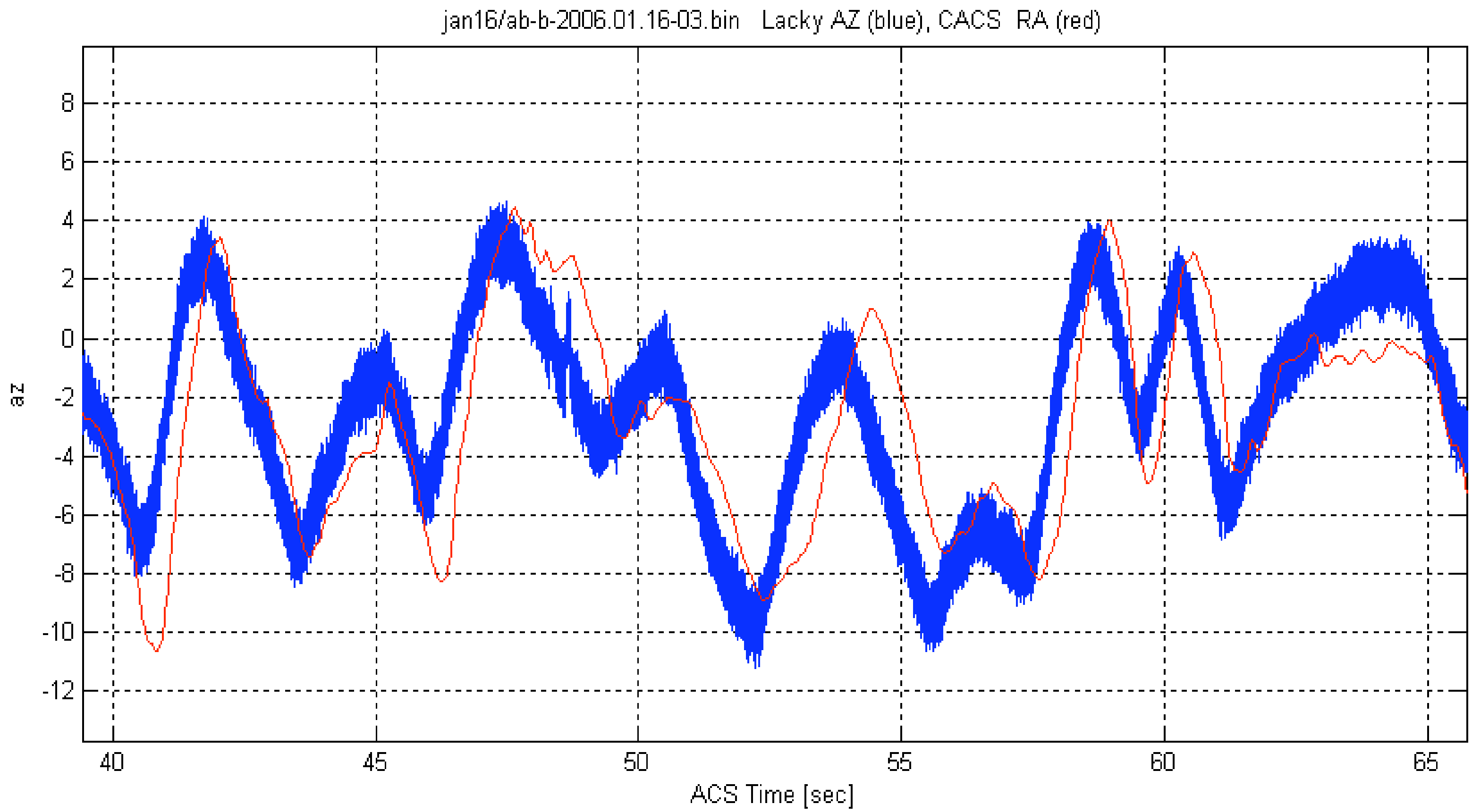
- 36.220 McCandliss TBD
  - Target position within +/- 5 arc-min
  - Command Uplink to 10 arc-sec Slit
- 36.224 Cash Nov 2006
  - Initial acquisition within +/- 5 arc-min
  - Final acquisition within +/- 15 arc-sec (with uplink)
  - Less than 5 arc-min total drift
- 36.207 Cruddace Nov 2006 (AeroJet)
  - Less than 1 arc-sec/sec jitter
  - Less than 0.2 arc-min/min drift
  - +/- 2 arc min target
- 36.225 Chakrabarti Jan 2007
  - Must acquire within 1 arc-sec
  - Very precise control based on science provided “perfect” error signal
- 36.226 Bock May 2007
  - 3 arc-sec max error in 20 seconds
  - Side looking ST-5000
- 36.235 Harris Jun 2008
  - 20-30 arc-sec



Celestial ACS Challenges

- Fine pointing performance (~ 1 arc-sec) requires upgraded rate gyros.
  - Near-term approach: Retain GLN-MAC
  - Add LN-251 Digital IMU as precise rate gyro
    - 2 on order ~ $57,000 ea, delivery Dec 06
    - Will soon get “loaner” LN-250 vs. LN-251 (3” vs. 5”)
- Redesigned tri-level pneumatics for fine pointing & Chakrabarti
  - Axially-mounted valves at the nozzle block – reduces ullage.
  - Very fast valves for Chakrabarti, delivery August 06
  - Air Bearing prototype complete
- Chakrabarti is a particularly challenging mission
  - But it IS possible without LN-251
  - Need to get into 10 arc-sec box on our own
  - Then use experimenter’s “perfect” error signal
  - No way to test closed-loop performance – will feed back Lackey signal

Laser Autocollimator Compared to Celestial



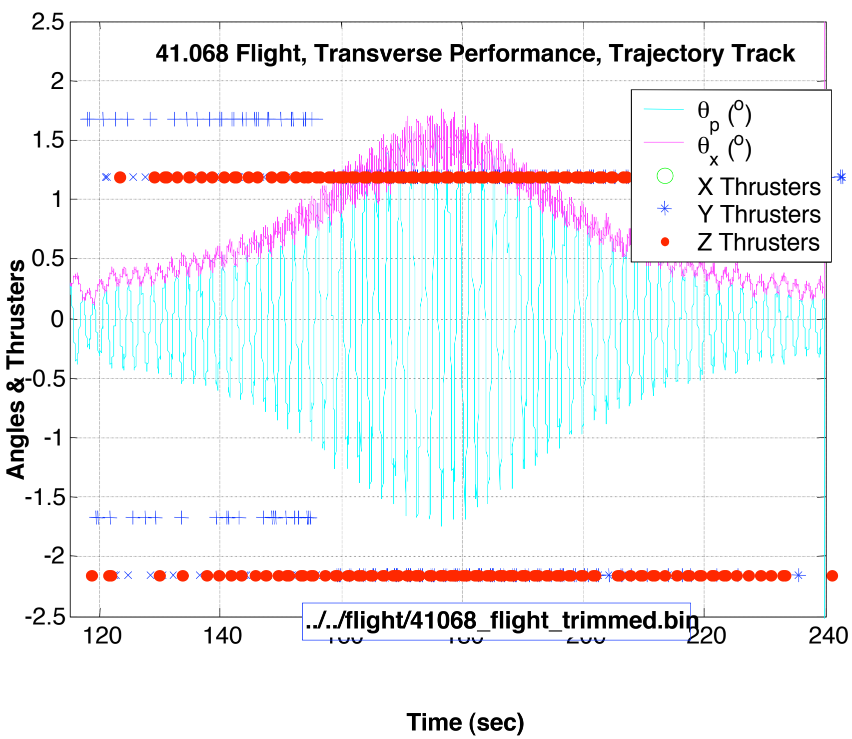
GNC – Boost Guidance Systems

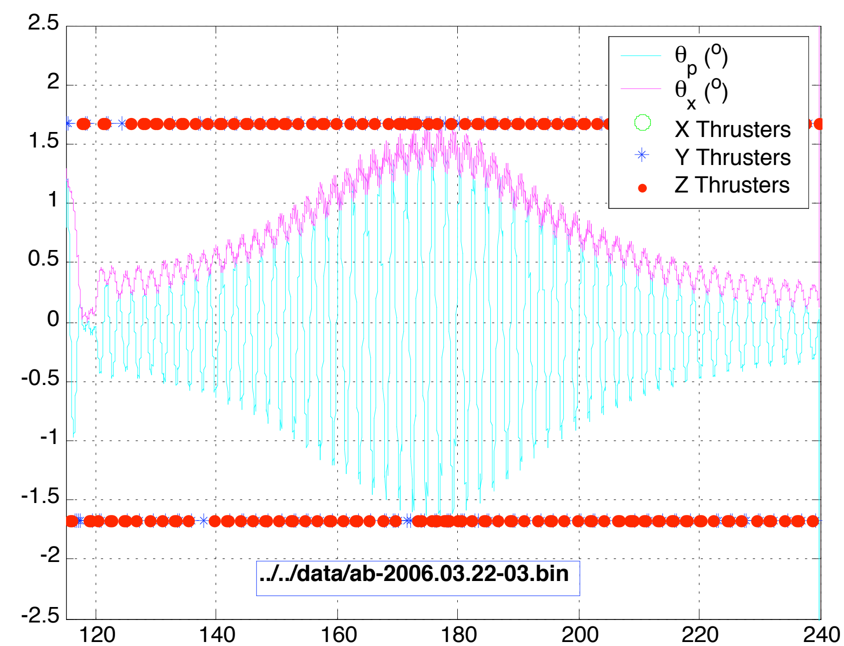
- 3 refurbished MIDAS gyros left for S-19A system (one is modified TM gyro)
  - Scheduled for McCammon, Hassler, Judge
  - At this time there is NO SPARE MIDAS (one more possible)
- 3 S-19D w/DMARS
  - One at WSMR for Cash
  - 2 in refurbishment at SAAB for Cruddace and Woods
  - Approx 4 month refurbishment cycle for S-19D
  - T100 gyros – DMARS refurbishment complete
- 2 S-19L systems at WFF, 2 more to be delivered in June 2006..
  - Strap-down LN-200 may be only adequate for Rail Attitude Hold.
  - More reliable without gimbal
  - Reimbursable missions made procurement possible
  - Audenaert 32.237 & 36.238 both flying S-19L (currently in Integration)
- S-19G design available
  - Both designs build on existing DS-19 design & software, replace DMARS, and Incorporate SAAB Guidance Processor Unit (GPU) which accepts raw LN-200 data

Seybold 41.068 Performance Velocity Vector Steering

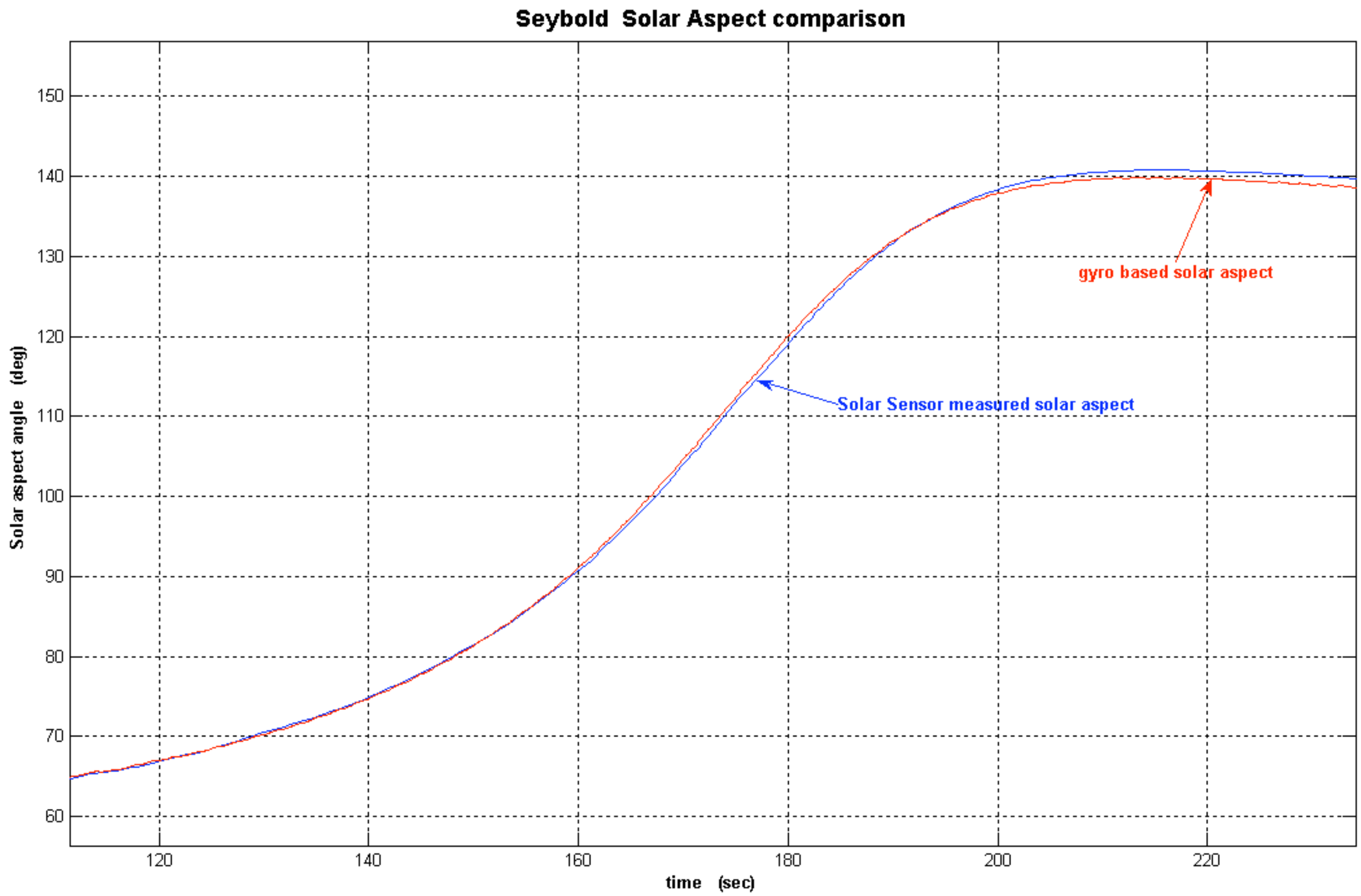
Comparison of Flight & Airbearing

- Very close agreement between airbearing indications and actual flight performance.
- Flight error is noisier, presumably due to “real” GPS input.





GLN-MAC Performance
Seybold 41.068



GLN-MAC Performance
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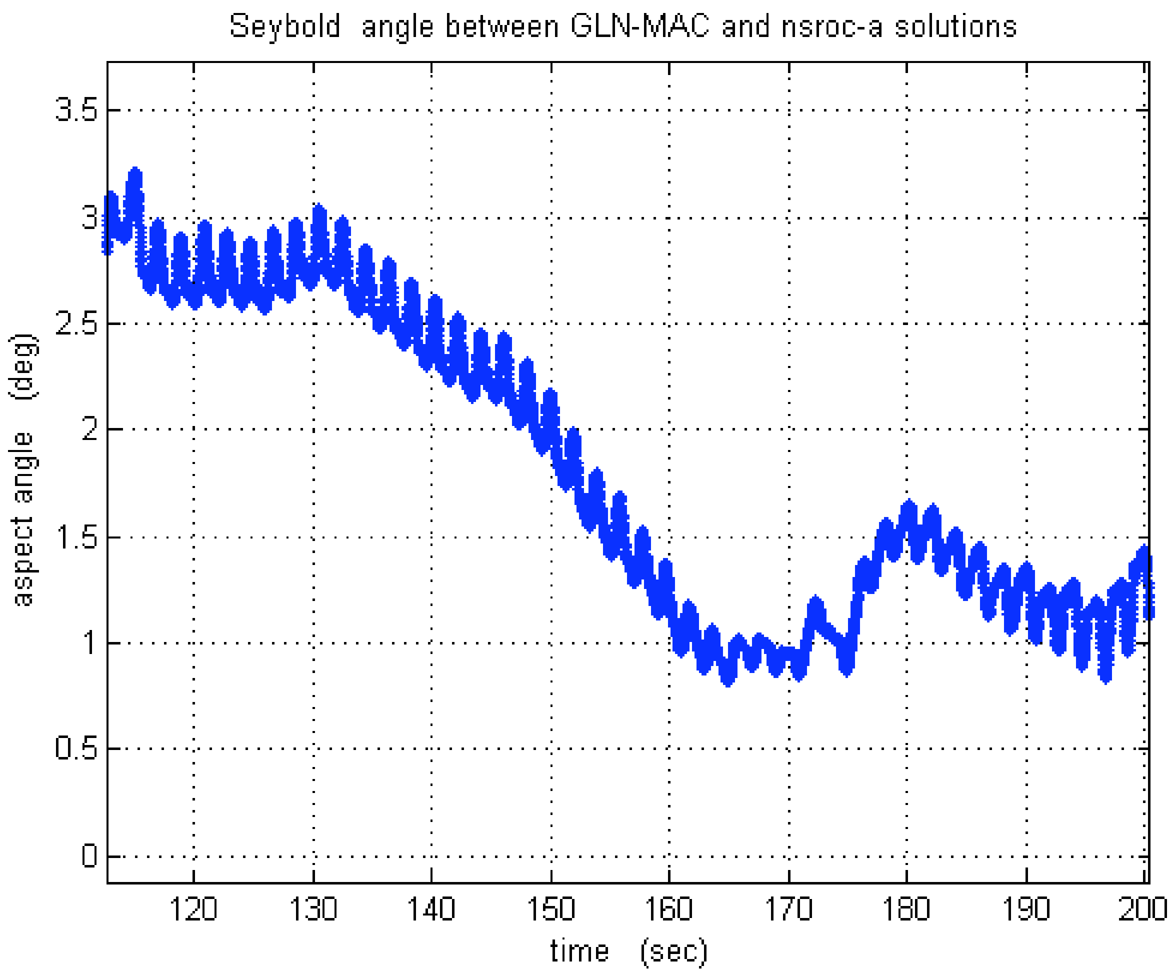
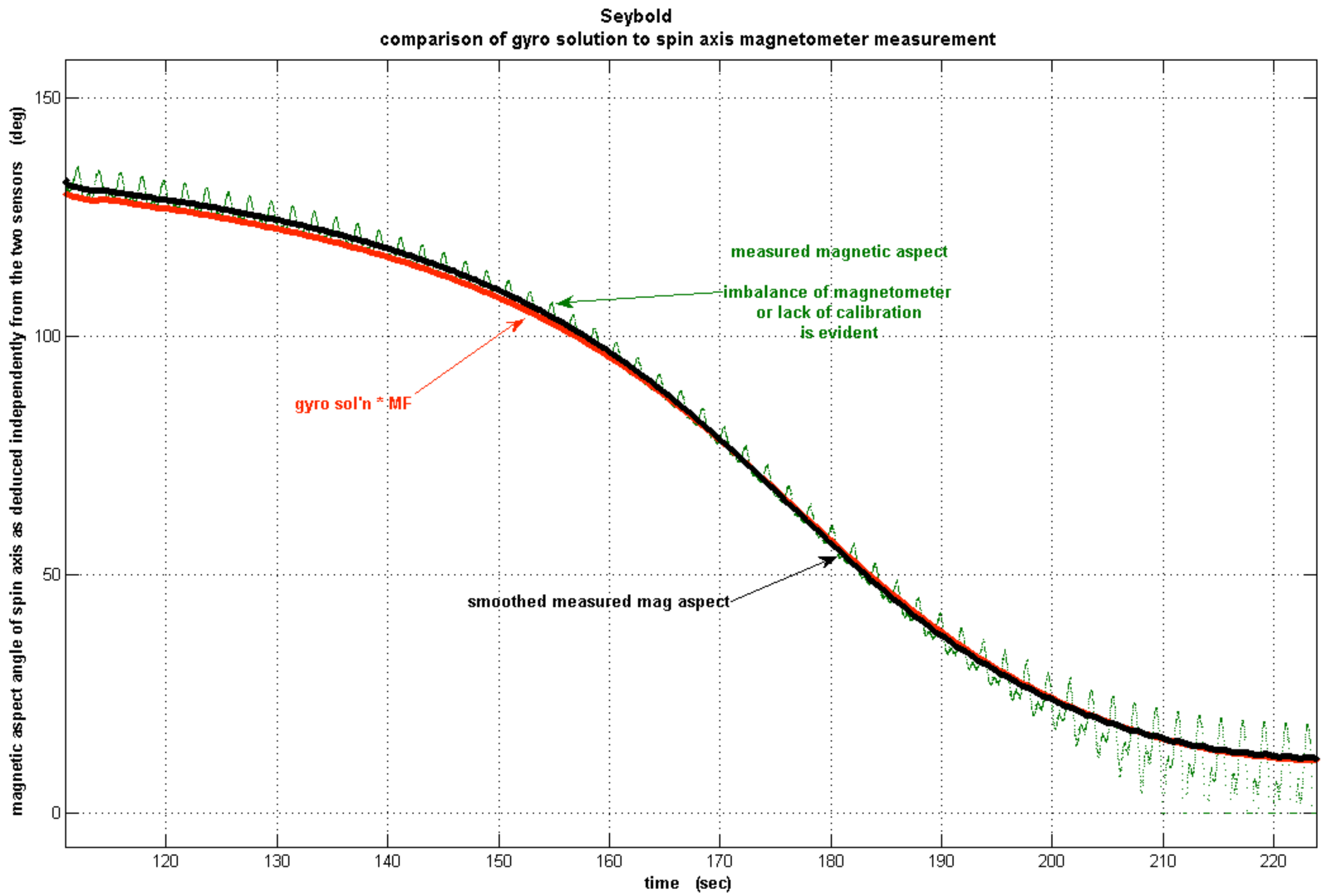
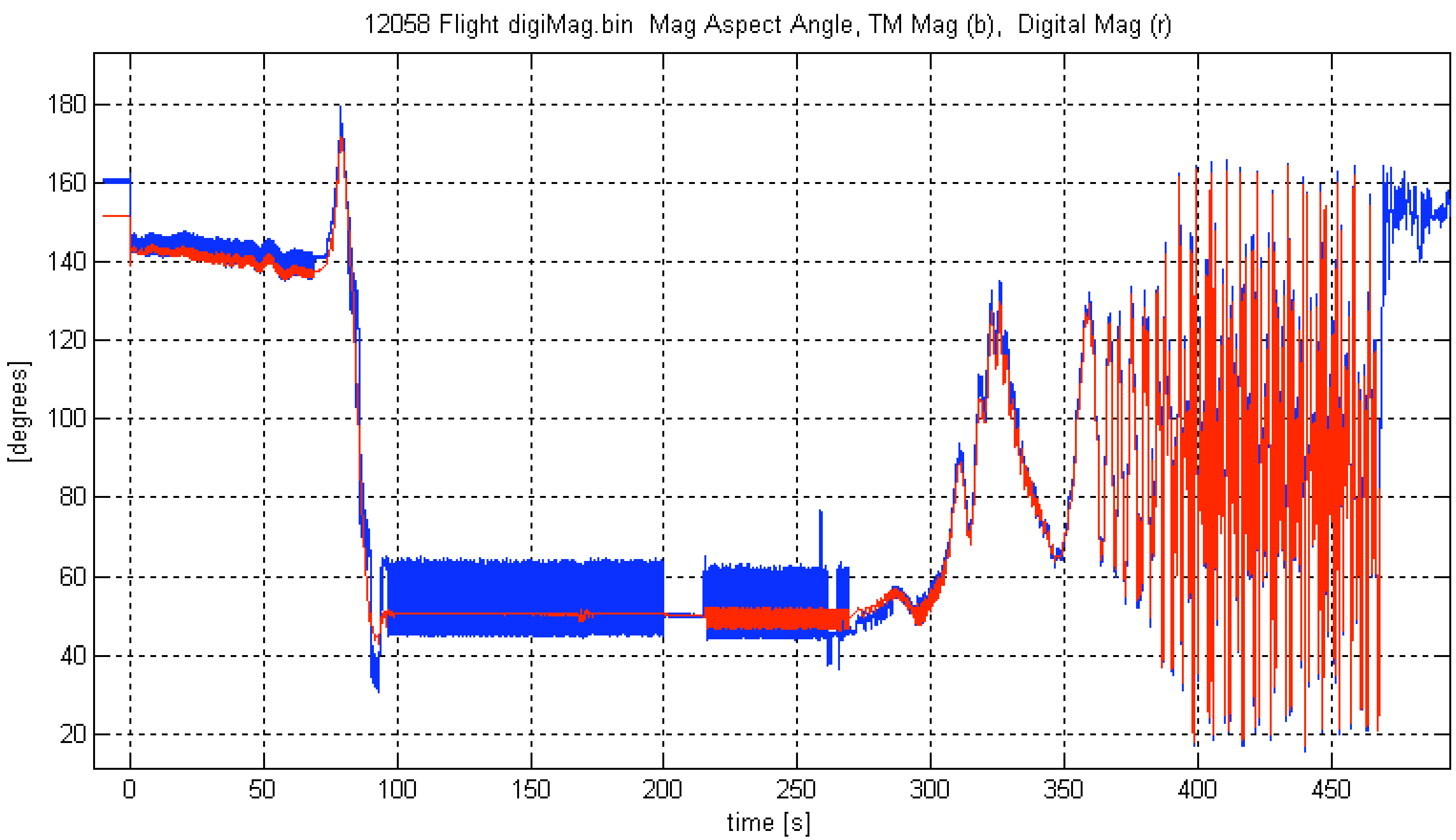


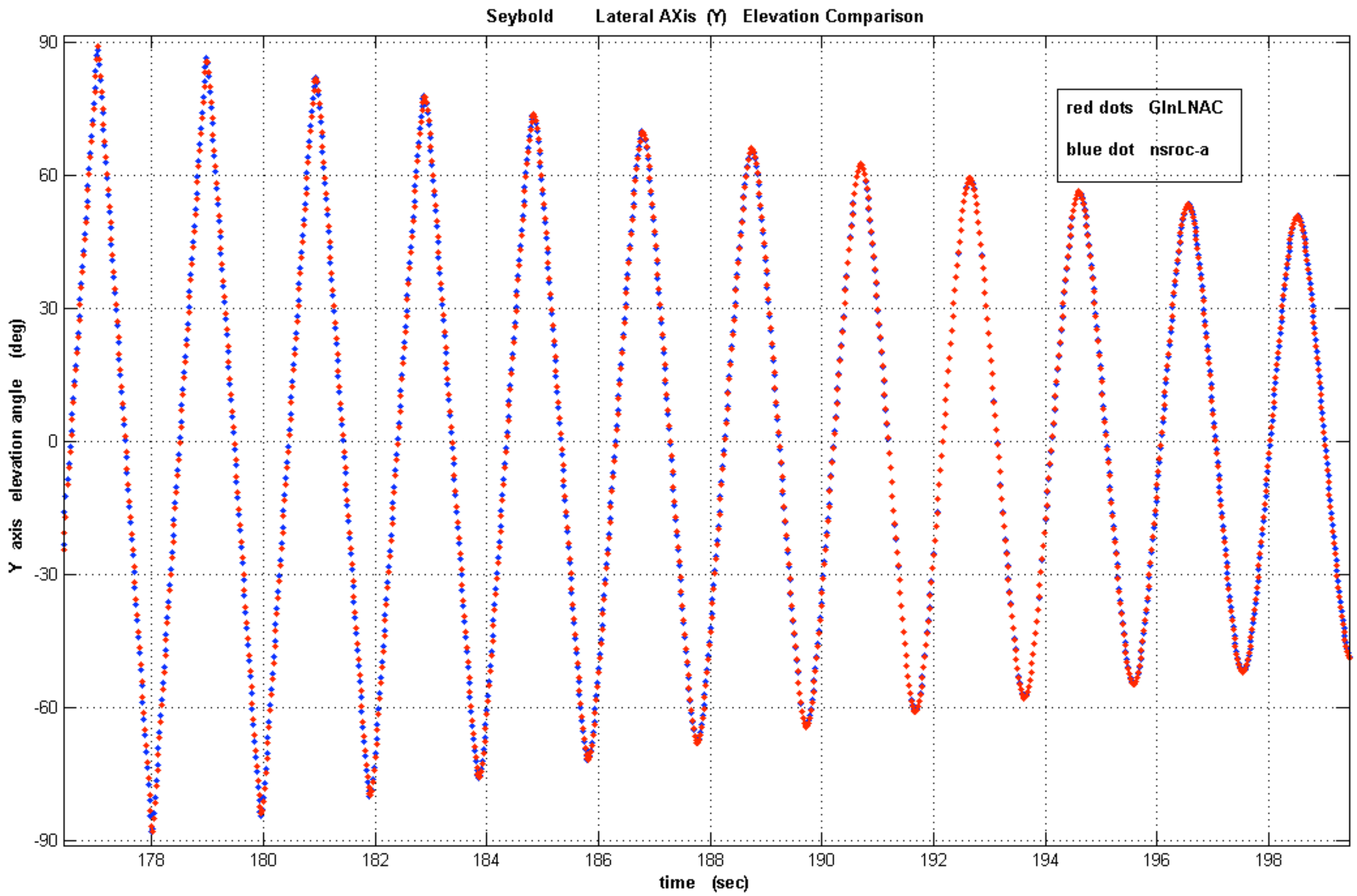
GLN-MAC Performance
Seybold 41.068



Digital Magnetometer Performance



GLN-MAC Performance
Seybold 41.068



Poker Flat Campaign 2007

- Larson –
  - 2 NMACS
  - Similar to Joule
  - Also 2 chemical rockets
- Lessard –
  - NIACS
  - Complex sub-payloads
- LaBelle –
  - NMACS
  - Straightforward mission
- Craven –
  - NIACS
  - Trajectory modification similar to Conde
  - Also three instrumented chemical rockets

Electrical Engineering

Shelby Elborn

Programmable Monitor Box

Program Benefits

- Replaces 7 existing monitor box circuit designs
- Allows complete assembly, verification, board potting prior to stocking
- Boards will be pulled from stock and programmed for mission needs.
- RS422 and synchronous serial digital data output will simplify payload wiring.

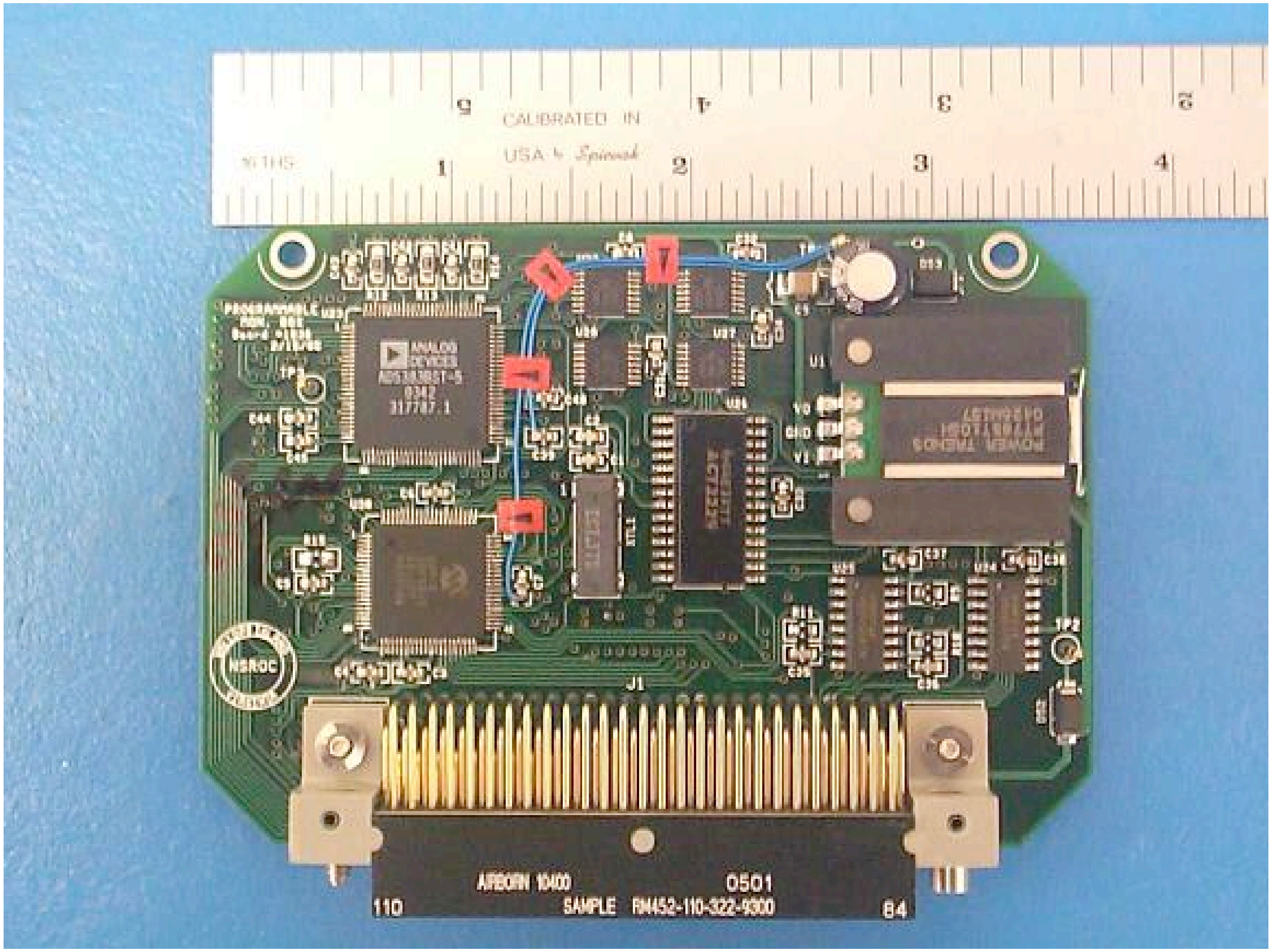
Implementation

- 12.063 Hickman: Used to monitor Dual RMFT driver +28V output and condition to +5 volts for LCTE analog inputs.
- 41.068 Seybold: Used to monitor the PIB voltages, currents and temperatures.

Flight Test Results

- 12.063 Hickman: Received data for entire flight on both DAC and asynchronous data outputs. Determined DAC data output needs additional design attention to improve data quality.
- 41.068 Seybold: Received data for entire flight on both DAC and asynchronous data outputs.

Programmable Monitor Box



Command Uplink Receiver

Program Benefits

- These new receivers will allow replacement of the 13 year old AV hardware.
- New receivers will simplify Instrumentation System wiring and allow for a more compact payload mechanical layout.

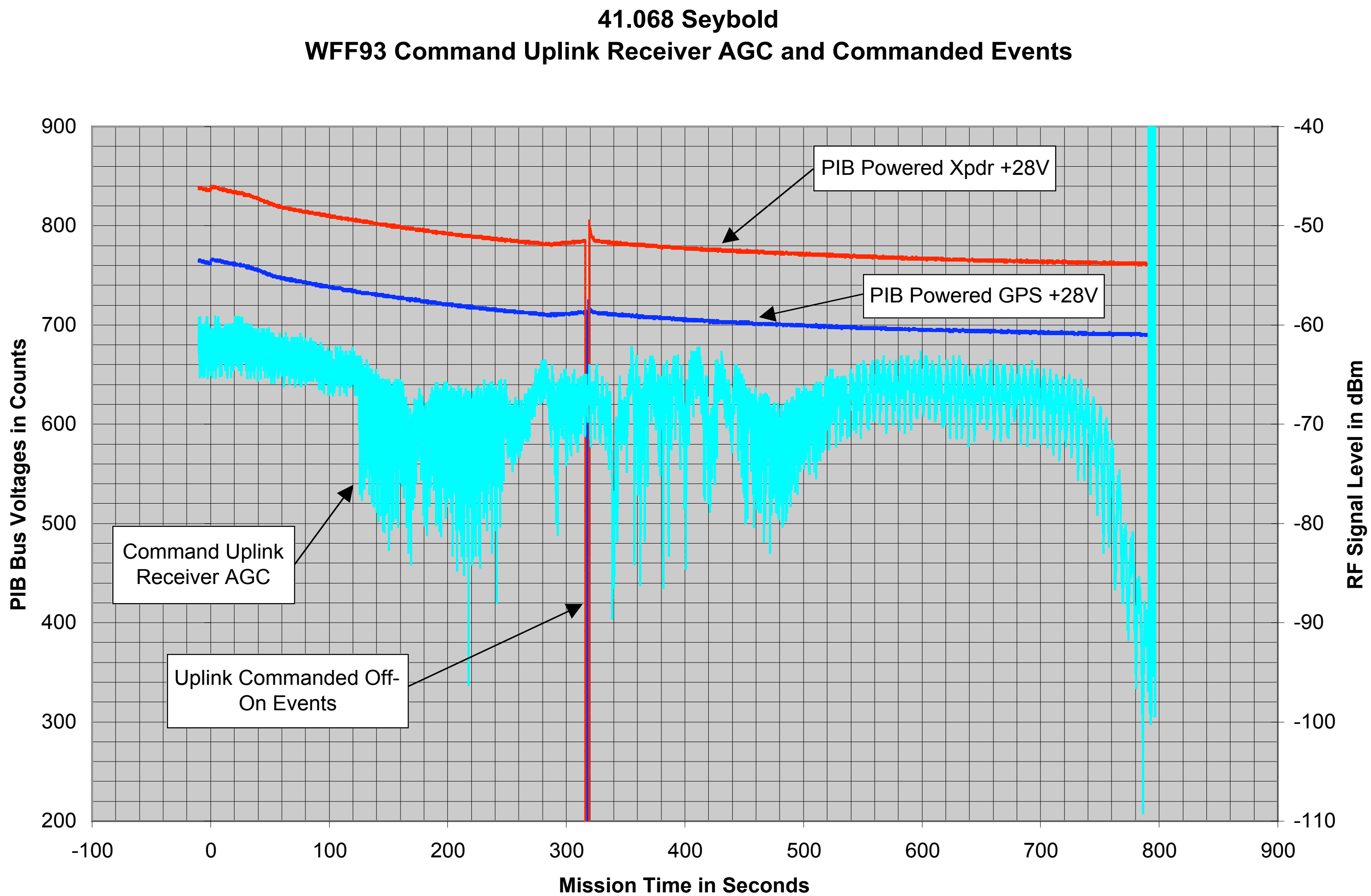
Implementation

- 12.063 Hickman: Configured to output ground transmitted 437.5 MHz with 115.2 K baud asynchronous data (set for character generate mode) to airborne asynchronous PCM data module input.
- 41.068 Seybold: Configured to output ground transmitted 437.5 MHz with 100 Kbps multiplexed RS232 data to Airborne Bit Sync/Decommutator.

Flight Test Results

- 12.063 Hickman: Received 115.2K baud data entire flight with excellent data quality and strong RF signal level.
- 41.068 Seybold: Received 100K bps signal entire flight with 6 uplink commands issued and all successfully implemented during the flight.

Command Uplink Receiver Data
from 41.068 Seybold



S-Band Transmitters
Wide Bandwidth, High Efficiency

Issues
- Currently any PCM downlink operating over ~1.5 Mega Bit Per Second requires using a 10-Watt S-Band transmitter whether we are going 100 km or 1000 km.
- The 10-Watt transmitter requires 3.1 Amps to operate and generates ~75 Watts of heat
- Existing 2, 5 & 8 Watt narrowband transmitters are not frequency agile.

Solution
- Procure new higher bandwidth, higher efficiency frequency agile units

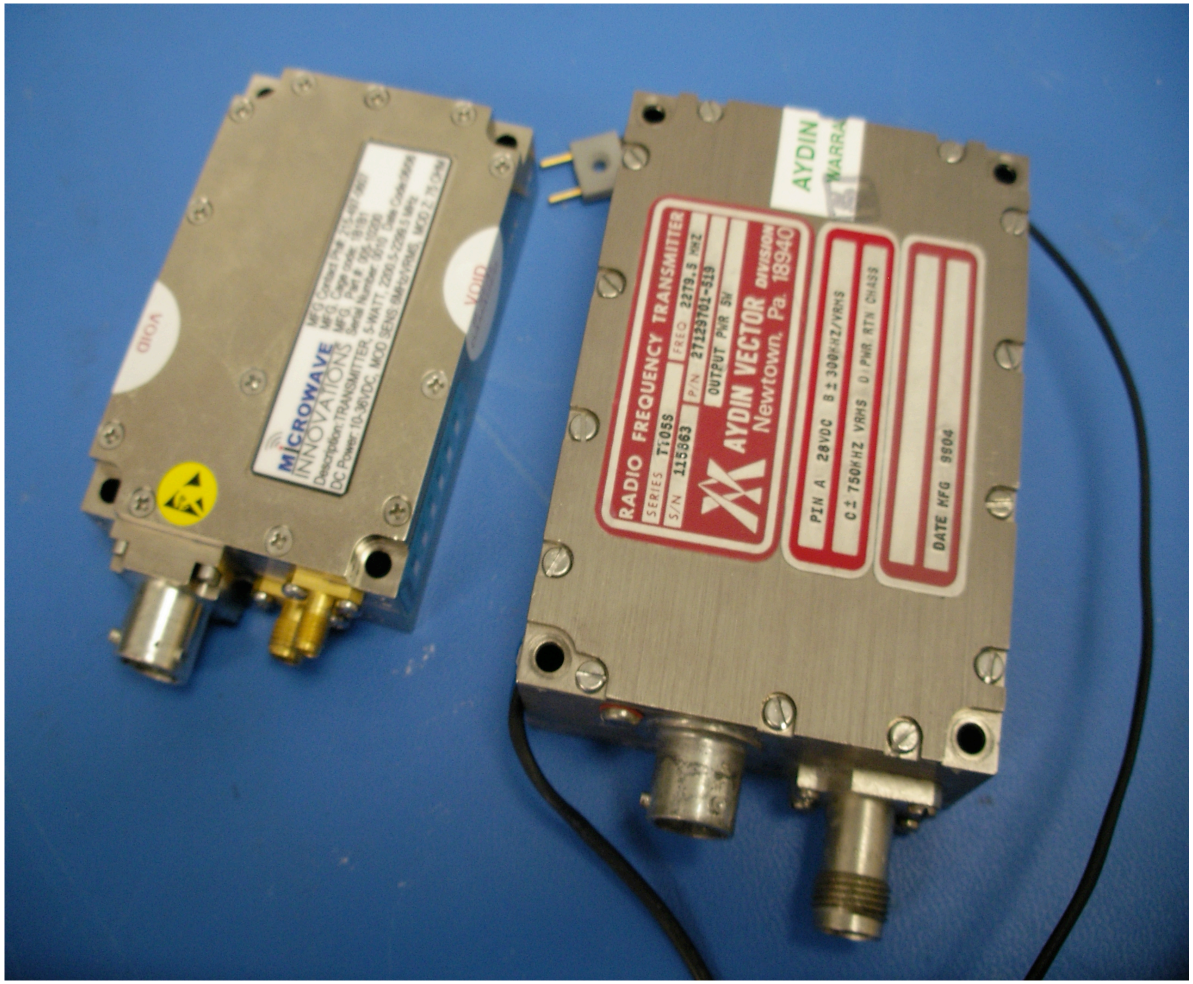
Program Benefits
- Reduced payload weight due to smaller battery and heat sinking mass requirements.
- Frequency agility allows only having to purchase/stock one model per RF power rating

Implementation
- Microwave Innovations developed 2 Watt and 5 Watt, 10 MHz 30% efficiency frequency agile S-Band transmitters and First Article 2 Watt used on 41.068 Seybold.

Flight Test Results
- 41.068 Seybold:
  - Good RF signal received entire flight plus TV video during recovery.

NSROC
Meeting the Challenge of the New Millennium

5 Watt S-Band Transmitter
Wide Bandwidth, High Efficiency



2 Watt S-Band Transmitter

Wide Bandwidth, High Efficiency

Beacon PCM and Beyond

. **Program Benefits**

- Allows range TM tracking as well as Radar assets to certify proper tracking operation prior to actual payload launch.
- Eight analog data channels allows assessment of payload health during flight as well as providing a mechanism for Range TM to certify proper data decommutation and recording.
- Can be used with the MLRS as an inexpensive TM tracking assessment tool or for a low cost student payload instrumentation package.

Implementation

- 12.063 Hickman: Unit configured for 8 analog data inputs and data rate set for 3.906 K bps. Encoder digital output fed to analog data channel input of WFF93 encoder.

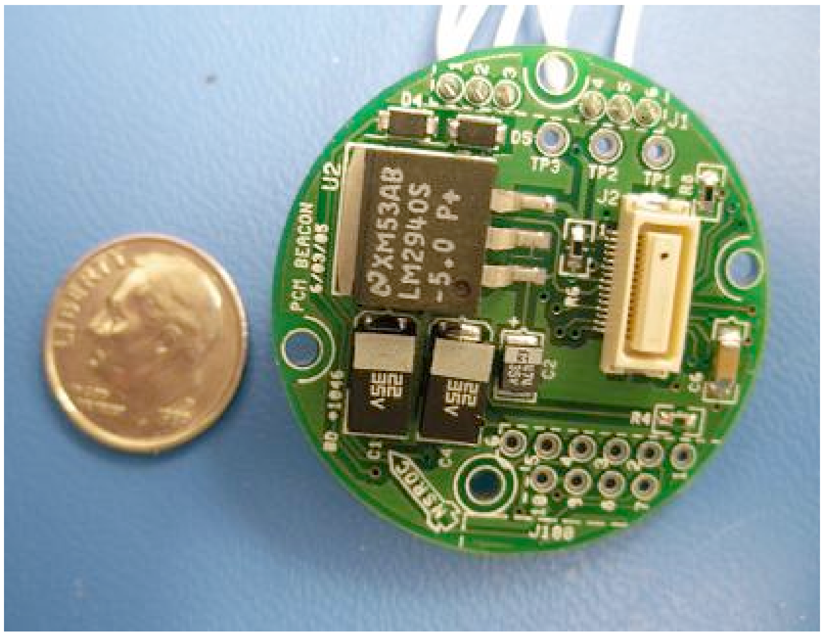
Flight Test Results

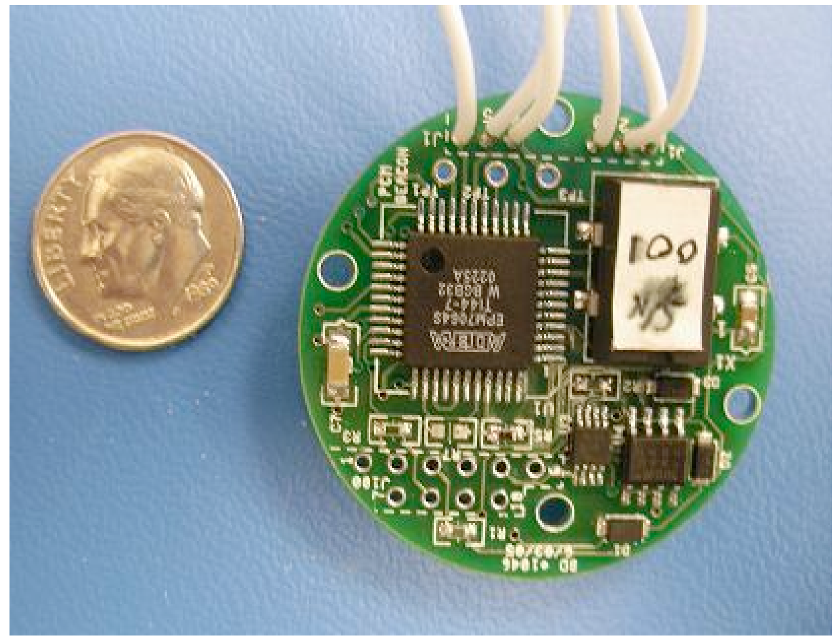
- 12.063 Hickman: Excellent data received for entire flight.

Future Plans

- Use knowledge, experience and flight test results of Beacon PCM development as guide to develop miniature PCM encoder for new MLRS-Mesquito payload with data rates to 2 Mbps.

Beacon PCM





Payload Power System

Program Benefits

- Reduces the landline requirements. Allows power system to be tested prior to installation in the payload.
- Incorporates bus monitoring and provides analog and RS232 outputs.
- Simplifies payload wiring.

Implementation

- 12.063 Hickman:
  - Used to provide +28V NiMH battery power to 4 sets of high power load resistors. Current set for ~2.5 Amps for 3 switched outputs and 1.5 Amps for continuous load output.
- 41.068 Seybold:
  - Used to provide +28V NiMH battery power and in-flight on/off control to new high efficiency 2 Watt S-Band transmitter & current sensor.

Flight Test Results

- 12.063 Hickman:
  - Flight configured with no G-Switched power backup and no inadvertent power switching noted throughout flight and no in-flight anomalies.
- 41.068 Seybold:
  - The system worked flawlessly with the CU system used to switch the PIB GPS and Xpdr power off and on several times in-flight.

Future Plans

- Update electrical design to allow reduction of unit size by 1/3 to _.

Payload Power System

Nickel Metal Hydride Batteries

Issues

- Existing Nickel Cadmium battery systems are heavy.
- NiCad batteries are being phased out due to environmental concerns.

Solution

- Utilize new battery technology.

Program Benefits

- Reduces overall payload weight.
- Easier disposal of exhausted cells.

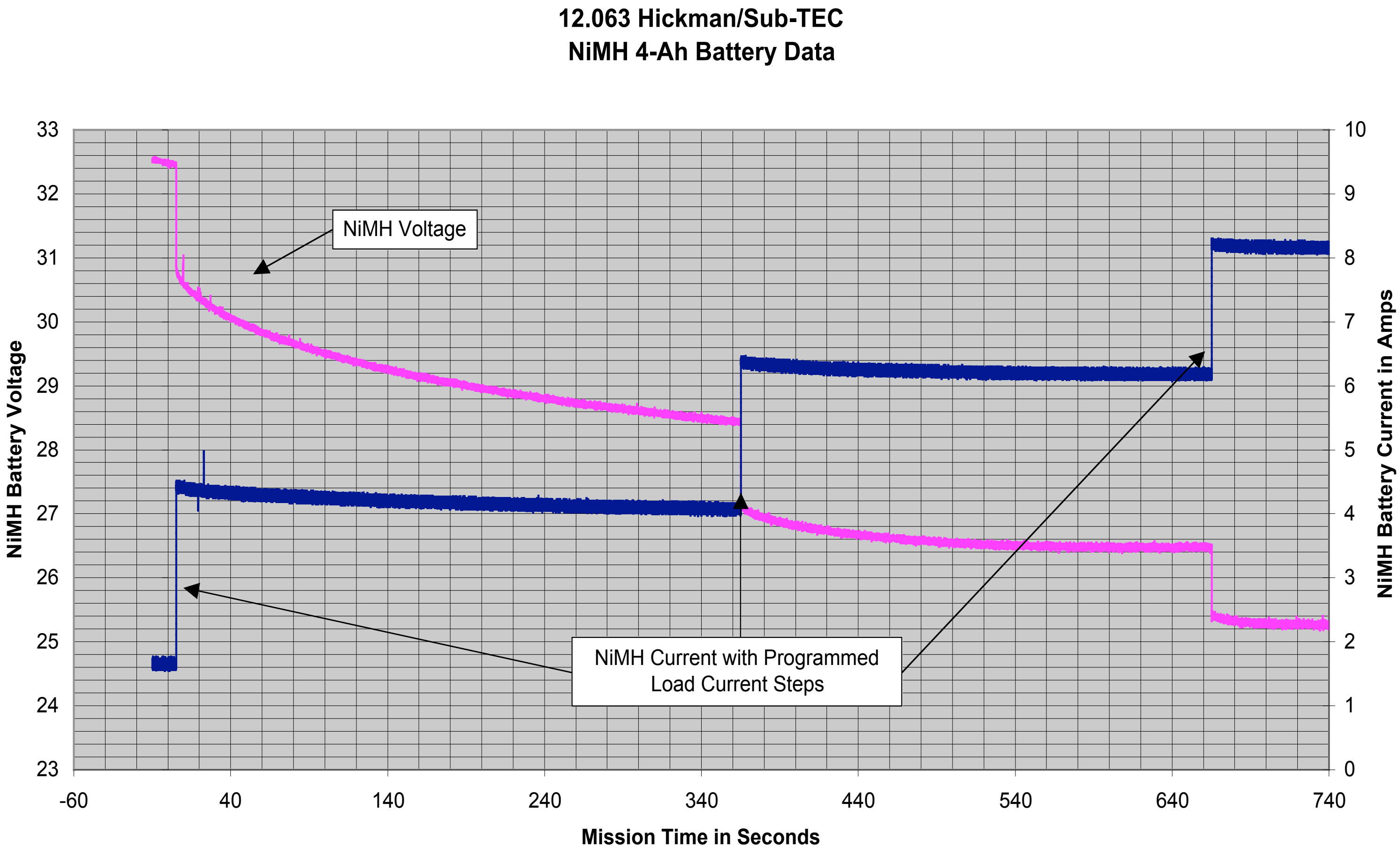
Implementation

- 12.063 Hickman:
  - 4 A-hr pack used to provide power for the PIB switched power outputs from 1.4 Amps to ~8 Amps at end of flight.
- 41.068 Seybold:
  - 0.8 A-hr used to provide power for new 2 Watt S-Band transmitter and current sensor.

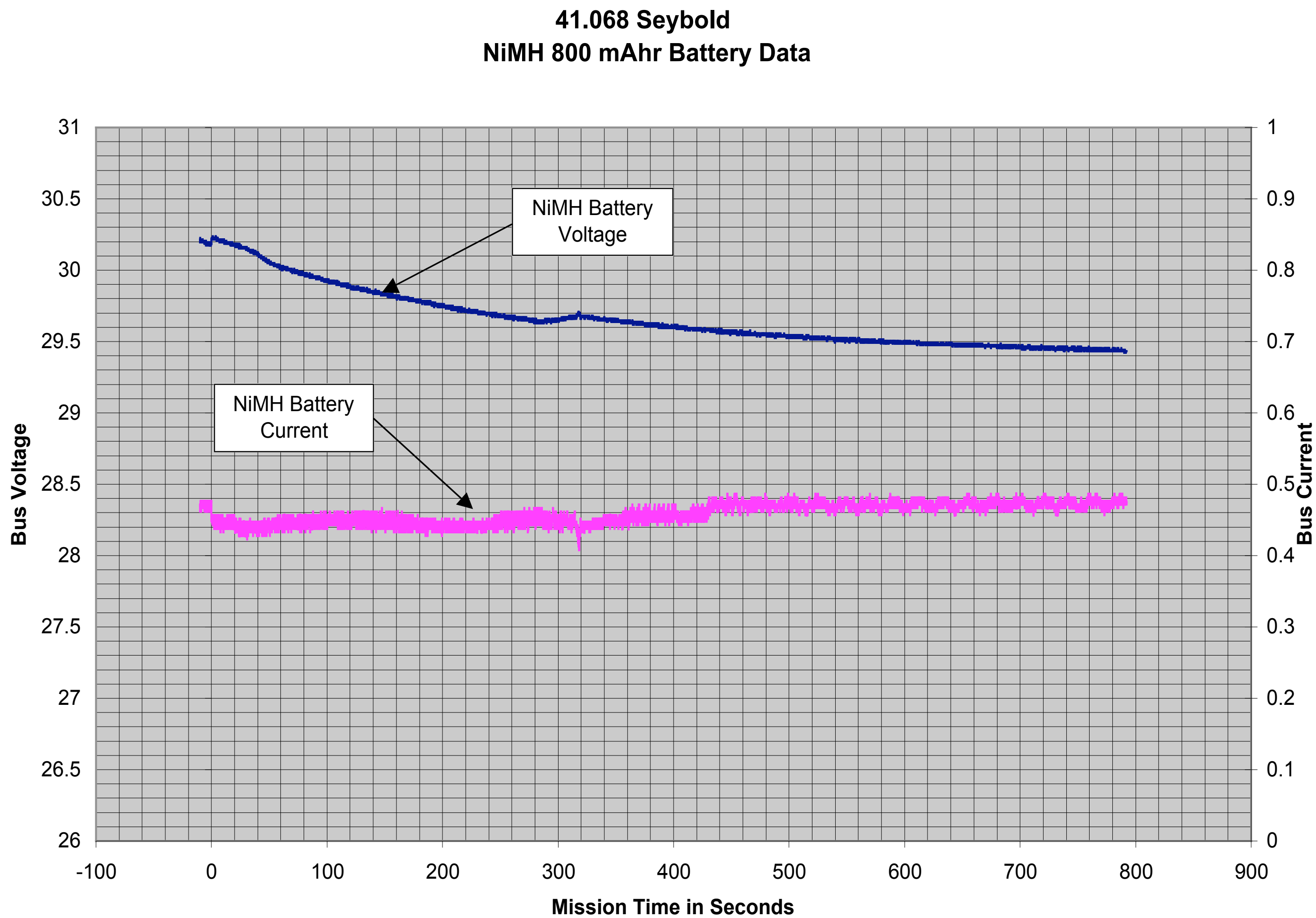
Flight Test Results

- 4 A-hr pack voltage 25.3 volts at +830 sec at over 8 Amps load current.
- 0.8 A-hr pack voltage 29.4 volts at +792 sec at 0.46 Amps load current.

Nickel Metal Hydride Batteries
12.063 Hickman Flight Data



Nickel Metal Hydride Batteries
41.068 Seybold Flight Data



Mechanical Engineering

Giovanni Rosanova

SRWG January 2006 Finding #3
Payload Vibration Testing

- NSROC has characterized Terrier Mk70 – Improved Orion, Terrier Mk12 – Improved Orion, and Black Brant IX vehicle flight load envelopes
- There is enough statistical confidence in this small data set that a new testing philosophy can be developed and gradually implemented for payloads flying on these vehicles
- Flight data collected thus far does not show dominant single-tone or sweeping sinusoidal input to the airframe, but tonal responses in internal structures are possible
  - This was expected, but needed to be proven with real data
- NSROC plans to conduct a non-advocate review of our data collected thus far and intended testing approach changes in August-September time frame
  - Request a member of science community to participate

SRWG January 2006 Finding #3

Payload Vibration Testing

After the NAR………………

- Propose that the Poker 2007 payloads flying on Terrier MK70 - Improved Orion vehicles be subjected to this new approach, which will include…
  - Three axis random only on the full payload
    - Possibly perform thrust sine on sections that are NSROC's responsibility
  - Levels defined based on predicted dynamic pressure, plus a factor of safety; e.g., 2.0 for acceptance, 2.5 for qualification, 3.0 for ultimate design
  - Duration based on actual flight time
- Propose that payloads flying on BB-class and other vehicles be subjected to heritage loads, except…
  - Waive thrust sine on full payload; i.e., perform three axis random only
  - Possibly perform thrust sine on sections that are NSROC's responsibility

SRWG January 2006 Finding #3

Payload Vibration Testing

After the NAR………………cont'd

- Continue collecting flight data on BB-class and other vehicles to obtain test levels that are based on predicted dynamic pressure
- Transition all payloads to new testing approach

Conclusions

- NSROC is committed to continuing the SRPO mission and program successes.
- NSROC's Primary Goal is to satisfy the Code S PI mission requirements.
- NSROC is committed in expanding the technical innovations while
  - Meeting the requirements of the PIs
  - Maintaining a cost effective environment
  - Making effective use of the in-house talent, experience and hardware.
- NSROC's receipt of the SRWG findings is important for future growth planning.